

# Bone regeneration with plasma-rich-protein following enucleation of traumatic bone cyst

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## ABSTRACT

Traumatic bone cyst is an uncommon non-epithelium lined cavity and is seen frequently in young individuals. The lesion occurs more commonly in the mandible, involving the posterior region. It is generally asymptomatic and is diagnosed on routine radiographic examination. The cystic cavity is usually empty and there is scanty material for histological examination. Surgical curettage is usually done and recurrence is rare. A case of traumatic bone cyst occurring in the anterior region of mandible in a young boy is presented. Following surgical intervention, plasma-rich-protein was placed in the cystic cavity. The lesion showed progressive resolution and bone regeneration of the cystic cavity within a short period of time.

**Key words:** Bone regeneration, cyst, plasma-rich-protein, trauma

## INTRODUCTION

Cystic jaw lesions may be epithelial or non-epithelial, odontogenic or non-odontogenic, developmental, or inflammatory in origin. The distribution of traumatic bone cyst according to diagnosis in a general population has been reported to be 1%.<sup>[1,2]</sup>

Traumatic bone cysts were first described in 1929.<sup>[3]</sup> The other names for this lesion are solitary bone cyst, hemorrhagic bone cyst, extravasation cyst, unicameral bone cyst, simple bone cyst and idiopathic bone cyst. The term "cyst" is a misnomer because these intra-bony cavities are not lined by epithelium. It is an unusual benign, empty or fluid-filled lesion. They are commonly found in the metaphysis of long bones, but are rare in the jaws.<sup>[4]</sup> Traumatic bone cysts may be classified as unicameral,<sup>[5]</sup> simple,<sup>[6]</sup> solitary,<sup>[7]</sup> hemorrhagic,<sup>[8]</sup> or idiopathic.<sup>[9]</sup>

Although most cases of traumatic bone cysts present in young patients, before 18 years of age, they may be

detected at any age.<sup>[10-13]</sup> Solitary bone cysts develop most commonly during skeletal growth.<sup>[14]</sup> Their occurrence is more predominant in males,<sup>[15]</sup> with a ratio of 3:2.<sup>[10]</sup> A few studies have reported no sex preference.<sup>[12,13]</sup>

Although the posterior region of mandible is more commonly involved, the incisor region is also affected in the young as this area contains more hematopoietic marrow.<sup>[10]</sup> The majority of posterior lesions are located in the body of mandible, between canine and third molar.<sup>[16]</sup> They rarely may be present in the maxilla.<sup>[17]</sup>

Clinically, they are usually asymptomatic and are often accidentally discovered on routine radiological examination. The radiographic picture is usually a unilocular radiolucent area with scalloped margins between the roots of teeth.<sup>[10,11]</sup> They may be multilocular, associated with unerupted or impacted teeth, and several cysts may be present in the same patient.<sup>[18,19]</sup> Overlying cortical bone may be seen as a thin shell of bone on an occlusal radiograph.<sup>[10]</sup>

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Owing to lack of unique clinical and radiographic features, it is important to establish the differential diagnosis between traumatic bone cysts and other bone lesions of the jaws – especially translucent lesions. The definite diagnosis of traumatic cyst can only be determined at surgery.

Platelet concentrates for surgical use are tools of regenerative medicine designed for the local release of platelet growth factors into a surgical or wounded site. Platelet-rich plasma (PRP) is a blood derivative generated by differential centrifugation in which platelets are concentrated in a small plasma volume. Autologous PRP is a source for obtaining growth factors especially, platelet-derived growth factor (PDGF) and transforming growth factor- $\beta$  (TGF- $\beta$ ) that are essential for bone regeneration. The use of PRP can accelerate and enhance body's natural wound-healing mechanisms. It has the benefit to form a biological gel that may provide containment, clot stability, and function as an adhesive.

## CASE REPORT

A 13-year-old boy reported to the Department of Pedodontics and Preventive dentistry with a chief complaint of sensitivity in the lower front teeth. Patient gave a history of trauma 3 years ago, following which he fractured his upper front tooth. There was no significant medical and/or drug history.

Extraorally there was a swelling in the mandibular anterior region, with intact overlying skin and obliterating the sub-mental contour. Intraoral examination revealed a non-vital maxillary left permanent central incisor. An intraoral swelling was seen in the mandibular arch, obliterating the anterior vestibule. On palpation, the swelling was

firm and expansion of buccal and lingual cortical bone was appreciable. The lower permanent incisors were tender on percussion and gave a positive response to vitality test. They did not show any mobility and the overlying mucosa appeared normal. Regional lymph nodes were palpable and not tender.

Both intraoral anterior occlusal and periapical radiographs were taken of the mandibular anterior region [Figures 1 and 2]. Radiographic examination revealed unilocular, well defined, radiolucent areas, measuring 1.5 cm, 1 cm, and 0.5 cm, respectively. The lesions extended from the mesial root surface of mandibular left canine to the mesial surface of contralateral canine. The involved teeth did not show loss of lamina dura and there was absence of root resorption.

Clinical and radiographic findings indicated the lesion to be a solitary bone cyst. Treatment planned was surgical enucleation of the cystic lesion, followed by placement of platelet rich plasma gel into the cystic cavity. Under local anesthesia, a crevicular incision was made and a mucoperiosteal flap was raised. A round bone cutting surgical bur was used to make an opening along the margins of the cyst. Entry into the cystic cavity showed it to be completely empty [Figure 3]. A gentle curettage of the bony walls was done in order to induce bleeding. The thin membrane obtained from the bony cavity was sent for histological examination.

### Preparation of autologous platelet rich plasma

Prior to the surgery, 10 ml of blood was drawn intravenously from the boy and collected in a sterile plastic vaccutube coated with an anticoagulant,



**Figure 1:** Anterior occlusal radiograph of mandibular arch showing presence of a cystic lesion



**Figure 2:** Intraoperative photograph of mandibular anterior region

sodium citrate. It was then centrifuged at 1300 rpm for 10 minutes, following which layers were obtained: an upper straw-colored fluid, which was platelet-poor plasma (PPP); a middle buffy coat rich in platelets and; a lower layer rich in RBCs.

The plasma, buffy coat and 1ml of RBC layer was aspirated into another sterile tube without anticoagulant. It was further centrifuged at 2400 rpm for 10 minutes, in order to separate the PPP from the PRP. The upper layer of PPP was discarded and PRP remained at the bottom of the tube in the form of a red button.<sup>[20]</sup> For purpose of activation, 6 ml of calcium chloride and thrombin was added and the resultant PRP gel was placed inside the bony defect [Figure 4]. Following soft tissue closure, the patient was prescribed antibiotics and analgesic- anti-inflammatory drugs for a period of 1 week.

Post-operative intraoperative periapical radiographs were taken immediately, and at monthly intervals. Healing

of the lesion together with bone regeneration was observed. At first month, resolution of the lesion was observed, followed by regeneration of bone in a relatively short time [Figures 5 and 6].

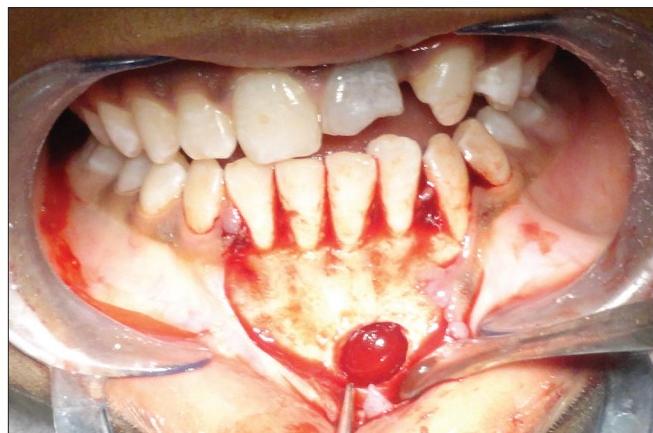
Histological examination showed fibrous connective tissue with occasional chronic inflammatory cells, including lymphocytes, fibrin, hemosiderin, and cementum were observed. No epithelial lining was present [Figure 7].

## DISCUSSION

Traumatic bone cysts are rare lesions of the jaws. In a pediatric group, with mean age of 14 years, 18% had traumatic bone cysts and the mean diameter of the lesion was 1.7 cm.<sup>[21]</sup> A higher prevalence in young patients, absence of a history of trauma, and a small number of lesions containing serous fluid with blood reflects the need to discuss the true pathogenesis of traumatic bone cysts.



**Figure 3:** Surgical entry into cystic cavity



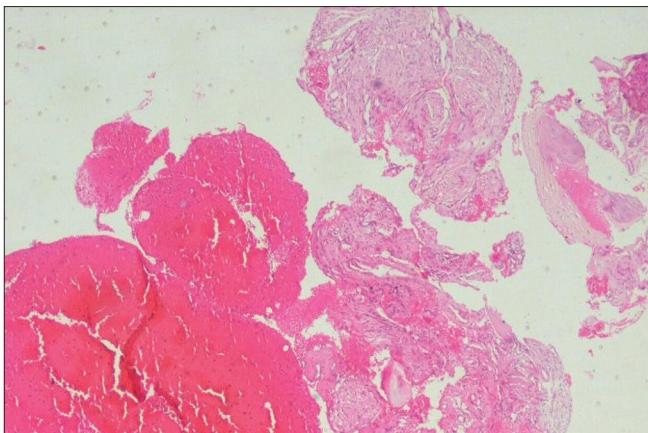
**Figure 4:** Cystic cavity after placement of plasma-rich-protein



**Figure 5:** Intraoperative periapical view at 1 month showing resolution of cystic defect



**Figure 6:** Intraoperative periapical view at 2 months showing regeneration of bone



**Figure 7:** Histological picture of traumatic bone cyst showing connective tissue and fibrin

The pathogenesis of traumatic bone cysts remains unclear and speculative. The most accepted version at present is the traumatic-hemorrhagic theory, which suggests that lesions develop if intramedullary clots due to trauma do not undergo lysis or resolution.<sup>[22]</sup> Traumatic bone cysts have a preference for the posterior areas (body and ramus) of the mandible; although the symphysis may also be a site.<sup>[18,19]</sup> The mandible has more cortical bone, and repairs itself more slowly compared to the maxilla. This theory explains why traumatic bone cysts occur more often in young individuals, an age at which trauma occurs more often. Trauma at the site of lesions and the presence of blood in the cavities are not common. This opens the possibility that micro-trauma of teeth and alveolar ridge are involved in the pathogenesis of traumatic bone cysts.<sup>[23]</sup>

Newton and Zunt emphasized that endodontic treatment in cases of traumatic bone cyst should be considered before, during or after the surgery.<sup>[24]</sup> In the present case, pulp of all four mandibular permanent incisors continued to remain vital, and therefore, no endodontic treatment or extraction was done.

Traumatic bone cysts may undergo spontaneous resolution. Failure to treat may lead to pathological bone fracture. The treatment of choice for traumatic bone cysts is surgery for curettage of the bone walls, which generally results in short-term healing<sup>[17,23,25]</sup> and recurrence is rare. Enucleation of lesion was the treatment of choice.<sup>[26]</sup> It was a one-stage surgical treatment followed by placement of PRP inside the bony cavity.

On surgical intervention, the bony cavity appeared to be empty. It has been noted that such content in the bone cavity may represent different stages in the

development of traumatic bone cysts.<sup>[27]</sup> The cavity may contain either a small amount of straw-colored fluid, shreds of necrotic blood clot, fragments of fibrous connective tissue.<sup>[10]</sup> Suei *et al.* evaluated whether gas was present in the cavity of simple bone cysts. Results showed the absence of water/air levels in these cysts on CT examination. This indicated that the operative finding of air in the cavity of simple bone cysts may have been in error at least in some cases.<sup>[28]</sup>

Presumptive diagnosis of a traumatic bone cyst was made at the time of surgery; since the thin connective tissue membrane was scanty for histology.

PRP works via the degranulation of the alpha granules in platelets, which contain growth factors. The active secretion of these factors is initiated by the clotting process of blood when PRP is activated by thrombin. The secreted growth factors immediately bind to their transmembrane receptors on adult mesenchymal stem cells, osteoblasts, fibroblasts, epithelial cells and then cause cellular proliferation, matrix formation, osteoid production, and collagen synthesis through cellular message transforming.<sup>[29-31]</sup> PRP also contain three proteins in blood known to act as cell adhesion molecules for osteoconduction and as a matrix for bone and connective tissue. These molecules are fibrinogen, fibronectin, and vitronectin.<sup>[32]</sup>

PRP placed along with bone graft bone appeared to enhance bone regeneration after cyst enucleation in pediatric patients.<sup>[33]</sup> Interestingly, in the present case, placement of PRP gel alone resulted in considerable filling of defect with bone within a short period. On coagulation, the PRP preparation assumes a sticky consistency due to its high fibrin content.<sup>[34]</sup> This "sticky gel" of PRP acts as a haemostatic agent, and stabilizes the blood clot. PRP also acts as an anti-inflammatory agent.<sup>[35]</sup>

The use of PRP increases the vascularity in the first 20 days, with an increase of osteoblast and immature osteoid tissue formation within 3-6 weeks, improving the quality and quantity of newly formed bone tissue. Histomorphological observations showed that 54% of patients treated with PRP achieved 100% bone regeneration within 24 weeks, compared with 38% of the control group.<sup>[36]</sup> This implies that there is acceleration of bone growth with PRP.

The use of PRP in young children could decrease the need for autologous bone grafts collected from extraoral sites, avoiding cutaneous incisions and reducing the extent of mucosal incisions. In the present

case, PRP resulted in the formation of healthy osteoid tissue within a short period, thus providing stability and support to the permanent teeth.

PRP could have a potential for routine use in regeneration of cystic bony defects in children. PRP is an autogenous preparation, and is inherently safe and free from concerns over transmissible diseases. The preparation of PRP is also simple and rapid.

## CONCLUSIONS

Traumatic bone cyst is usually found on routine examination. Careful curettage and the use of PRP can result in healing with faster favorable bone regeneration, and closure of bony defect. The use of PRP in children is safe, effective and easily available.

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